PHSB STUDIES

No. 9-B   April 1978

VARIATION IN CITY DEATH RATES IN NORTH CAROLINA

Since a recent PHSB Study—"Mortality in North Carolina Cities"—appears to have generated considerable interest if not unrest among city fathers and health officials, additional analysis of the city death rates was deemed desirable. This analysis purports to examine in greater detail than before the variation in the age-race-sex-adjusted rates (cause-specific) experienced by 38 cities during the period 1968-1972.

The previous study reported the highest and lowest city death rates with considerable differences being observed for each cause of death examined. However, the range alone does not adequately describe the variation associated with the entire spectrum of death rates. Obviously, a single outlier could be responsible for a wide range when, in fact, the other 37 rates are clustered within a very short range.

Three procedures are presently used to examine and describe variation among each of the cities' cause-specific rates:

1) *The coefficient of variation (CV) is a relative measure of variation and is defined as "the standard deviation expressed as a percentage of the mean." A large CV reflects greater variation than a small CV.*

2) *The chi-square criterion is used to test the null hypothesis of no significant differences among the 38 cities (see footnote).*

3) *For those causes associated with a significant chi-square (meaning that we reject the hypothesis of no difference among cities), cluster analysis is used to identify those cities whose adjusted death rates were high or low.*

Results

The CV's ranged from 12.4 for total cancer to 122.5 for hypertension. Arteriosclerosis, ovarian cancer and stomach cancer ranked behind hypertension as the causes associated with the greatest amount of variation. The CV's for these and other causes are given in Table 1.

Table 1 also contains the cause-specific chi-square values and their levels of significance. Note that some low and non-significant chi-square values (p > .05) are associated with a relatively large CV. This is because, despite large variation, the numbers of deaths involved are not sufficiently large to obtain statistical significance. In this sense, event frequency is highly important to the detection of significant differences.

For those causes associated with significant chi-squares (p < .05), Table 2 identifies the cities whose adjusted death rates were deemed by cluster analysis techniques (Statistical Analysis System) to be high. The cities listed are those whose death rates were at the highest level when we arbitrarily chose to cluster the 38 cities' cause-specific rates into five groups. The five groups may be considered to categorize death rates according to such labels as low, medium low, medium, medium high and high.

Table 1

Statistics Relative to Age-race-sex-adjusted Mortality
in 38 North Carolina Cities During 1968-1972

Cause of Death - Eighth Revision International Classification of Diseases, Adapted	CV*	Chi-square Value (x^2) and level of significance (p)	
		x^2	p
All Causes	12.7	1001.4	<.001
Heart Disease 390-398,402,404,410-429	17.8	581.9	<.001
Hypertension 400,401,403	122.5	422.2	<.001
Cerebrovascular Diseases 430-438	17.2	304.7	<.001
Arteriosclerosis 440	53.8	204.8	<.001
Cancer 140-209	12.4	89.2	<.001
Cancer of the Stomach 151	50.3	61.4	.007
Cancer of the Colon and Rectum 153,154	26.7	38.3	.410
Cancer of the Pancreas 157	41.1	65.1	.003
Cancer of the Trachea, Bronchus and Lung 162	28.9	90.5	<.001
Female Breast Cancer 174	29.7	42.4	.251
Cancer of the Cervix Uteri 180	44.1	48.4	.100
Cancer of the Ovary, Fallopian Tube and Broad Ligament 183	52.7	46.9	.129
Cancer of the Prostate 185	46.5	59.2	.012
Leukemia 204-207	37.0	45.7	.154
Diabetes Mellitus 250	31.0	80.0	<.001
Influenza and Pneumonia 470-474,480-486	26.4	124.7	<.001
Chronic Obstructive Lung Disease . . 490-493,519.3	29.1	69.7	<.001
Cirrhosis of the Liver 571	34.0	107.0	<.001
Nephritis and Nephrosis 580-584	43.4	50.5	.068
Motor Vehicle Accidents 810-823	31.1	172.3	<.001
Accidents Excluding Motor Vehicles 800-807,825-949	23.8	102.0	<.001
Suicide 950-959	39.5	63.0	.005
Homicide 960-978	37.5	123.6	<.001

*Coefficient of variation = standard deviation of the rates (s) expressed as a percentage
of the mean rate $(\bar{x})$; CV = $100s/\bar{x}$.

Table 2

Cities With the Highest Age-race-sex-adjusted
Mortality When Five Homogenous Groups
of Cities are Selected by Cluster Analysis*

North Carolina, 1968-72

Cause of Death	Cities in Highest Mortality Group Listed in Descending Order of the Magnitude of the Rate
All Causes	Hickory, Sanford
Heart Disease	Shelby, Sanford, Eden
Hypertension	Eden
Cerebrovascular Diseases	Hickory, Roanoke Rapids, Asheboro, Albemarle, Rocky Mount
Arteriosclerosis	Lumberton, Monroe
Cancer	Hickory, Kinston, Sanford, New Bern, Wilmington, Asheboro
Cancer of the Stomach	Hickory, Jacksonville, Lenoir
Cancer of the Pancreas	Sanford, Eden, Greenville, Chapel Hill
Cancer of the Trachea, Bronchus and Lung	Kinston
Cancer of the Prostate	Jacksonville
Diabetes Mellitus	Eden, Sanford, Jacksonville, Monroe, Elizabeth City, Asheboro
Influenza and Pneumonia	Asheboro, Gastonia
Chronic Obstructive Lung Disease	Sanford
Cirrhosis of the Liver	Morganton, Henderson
Motor Vehicle Accidents	Sanford
Accidents Excluding Motor Vehicles	Jacksonville
Suicide	Reidsville, Sanford
Homicide	Shelby

*Statistical Analysis System Cluster Program

Table 3 identifies the cities whose adjusted death rates were at the lowest level when rates were clustered into five groups. For most causes, we fortunately find more cities "like each other" at the lower end of the death rate range than at the upper.

Note: In order to use chi-square to test for significant differences among the 38 cities, we applied each city's average annual age-race-sex-adjusted rate to its 1970 population and multipled by five to determine an adjusted number of deaths during 1968-72. After determining that in no case was the "expected" adjusted number fewer than 2, chi-square was applied to the 2 x 38 contingency tables where rows represented (1) the five-year adjusted number of deaths and (2) the 1970 Census minus the adjusted number of deaths.

Table 3

Cities With the Lowest Age-race-sex-adjusted
Mortality When Five Homogenous Groups
of Cities are Selected by Cluster Analysis*

North Carolina, 1968-72

Cause of Death	Cities in Lowest Mortality Group Listed in Ascending Order of the Magnitude of the Rate
All Causes	Morganton, Chapel Hill
Heart Disease	Morganton, Chapel Hill
Hypertension	Morganton, Albemarle, Jacksonville, Roanoke Rapids, Salisbury, Raleigh, Elizabeth City, Rocky Mount, Chapel Hill
Cerebrovascular Diseases	Charlotte, Raleigh, Morganton, Elizabeth City, Shelby, Durham
Arteriosclerosis	Henderson, Statesville, Morganton, Elizabeth City, Albemarle, Chapel Hill, Charlotte, Fayetteville
Cancer	Morganton
Cancer of the Stomach	Shelby, Monroe, Sanford
Cancer of the Pancreas	Jacksonville, Monroe, Morganton, Lenoir
Cancer of the Trachea, Bronchus and Lung	Morganton, Chapel Hill, Eden
Cancer of the Prostate	Asheboro, Roanoke Rapids, Lenoir
Diabetes Mellitus	Lexington, Greenville
Influenza and Pneumonia	Monroe, Chapel Hill, Rocky Mount, Greenville, Jacksonville, Salisbury, Winston-Salem
Chronic Obstructive Lung Disease	Morganton
Cirrhosis of the Liver	Eden, Lexington, Thomasville, High Point, Elizabeth City, Greenville, Roanoke Rapids, Reidsville, Shelby, Burlington, New Bern
Motor Vehicle Accidents	Chapel Hill, Asheville, Raleigh, Durham, Greenville, Concord, Shelby, Jacksonville
Accidents Excluding Motor Vehicles	Greenville, Thomasville, Burlington, Chapel Hill, Morganton
Suicide	Henderson, Albemarle, Chapel Hill, Salisbury
Homicide	Henderson, Greenville, Roanoke Rapids, Elizabeth City, Wilson

*Statistical Analysis System Cluster Program

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